![Allied Vision logo]

WHITE PAPER

Benefits of CoaXPress

What is CoaXPress?

CoaXPress (CXP) is an asymmetric high-speed serial communication standard over coaxial cable. It is a digital interface specification and was developed for the machine vision industry. Its high-speed and high-bandwidth data transfer is perfect for machine vision applications which require high resolution imaging and fast transfer of images to the host computer.

CoaXPress was introduced in 2009 and has evolved over the years to its current variant, 4x CXP-6, which was released in 2015. The Japan Industrial Imaging Association (JIIA) manages the CoaXPress standard and is supported by both the Automated Imaging Association (AIA) and European Machine Vision Association (EMVA). CoaXPress achieved global standardization status in 2011. CoaXPress compliant devices support GenICam V2.3.1 or higher and SFNC V2.0 or higher.

CoaXPress is available in the following variants:

Variant name	Bit rate
CXP-1	1.25 Gbps
CXP-2	2.5 Gbps
CXP-3	3.125 Gbps
CXP-5	5 Gbps
CXP-6	6.25 Gbps
4x CXP-6	25 Gbps (6.25 Gbps per connection)

Table 1: CoaXPress variants and characteristics

As CoaXPress uses coaxial cabling it is ideal for applications and environments with medium to high electromagnetic interference. Coaxial cables are one of the best electrical mediums for high speed data transfer. Coaxial cabling is also a low-cost cabling solution that is easy to install and terminate connectors in the field.

Connectors

CoaXPress uses IEC standardized cabling and connectors which are suitable for most industrial environments. Cameras and frame grabbers have one of two types of connectors, 75 Ω DIN 1.0/2.3 type or 75 Ω BNC. Both of which are suitable for high vibration industrial environments.
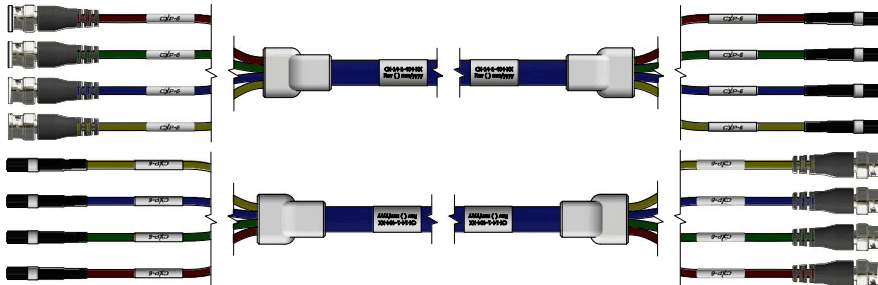

Figure 1: Cables and connectors

Applications

As noted, CoaXPress is ideally suited for applications which require high-speed and high-bandwidth image transfer. Factories are always looking to increase their throughput for higher profits, but of course they would still like to maintain or improve the quality of their products. In these situations, the speed of the vision inspection system is usually the limiting factor to capture the needed images. The higher bandwidth that is achieved with CoaXPress cameras enables an increased throughput compared to USB3 Vision and GigE Vision, and at a cheaper cost than 10 GigE Vision. Another advantage of CoaXPress in industrial applications is due to cabling and connectors. Coaxial cable is inexpensive and is more resistant to electromagnetic interference (EMI) because of its shielding. With a maximum cable length of 40 meters at the CXP-6 speed, it is a very stable, robust and flexible camera interface. Applications that can benefit from the CoaXPress interface include automated optical inspection, PCB inspection, wafer inspection, and flat panel display inspection.

The higher bandwidth of CoaXPress also allows for higher resolution sensors to be used for acquiring highly detailed images, yet still achieving the needed frame rates for the given application. Instead of using multiple lower resolution cameras to achieve the required frame rate for an application, a single CoaXPress camera with an equivalent resolution can be an option for a simpler and more cost-effective solution. An example application for these type of imaging systems could be aerial imaging and surveillance where a large area is needed to be imaged with a fast-moving drone or UAV, or train railway and power line inspection systems of high speed trains. The very low-latency of CoaXPress also makes it suitable for vehicle tracking and highway control in intelligent traffic systems (ITS) applications. Medical applications which depend on low latency and high resolution images, such as telesurgery systems, can also really benefit from using CoaXPress cameras.

Benefits of CoaXPress

CoaXPress offers many advantages over other interface standards for applications which require high speed and high bandwidth. Many high resolution sensors need to be "down-throttled" as standard Camera Link, Gigabit Ethernet, and USB interfaces do not have enough bandwidth to transfer images at a data rate that matches the sensor performance.

Beyond high-speed and high-bandwidth, CoaXPress provides benefits associated with Ethernet such as power over the interface and trigger over the interface which allows for a single-cable setup. CoaXPress provides up to 13 watts of power per cable, at a nominal 24 volts. Triggers on these high speed connects have high priority with low latency and high accuracy. The control protocol is designed to be tolerant of single bit errors with data protected by a CRC32 checksum which signals data errors. CoaXPress is also designed to be plug-and-play. It contains mechanisms for automatic link setup and the link is designed to automatically recover after a loss of connectivity.

The following table provides an overview of various low, medium, and high-speed interfaces:

	CoaXPress	USB3 Vision	GigE Vision	10 GigE Vision
Speed per connection	6.25 Gbps	5 Gbps	1 Gbps	10 Gbps
Total speed	25 Gbps (4x CXP-6)[1]	5 Gbps	1 Gbps	40 Gbps (4 cables)
Cable length	40 meters	16 meters	100 meters	100 meters[2]
Cable type	Coaxial (75 Ω)	USB 3.0	Ethernet (Cat-5 or higher)	Ethernet (Cat-6 or higher)
Cost of implementation	$$$	$	$$	$$$$
Frame grabber	Yes	No	No	No[3]
Interface technology	Mature	Mature	Mature	New
Power over interface	Yes[4]	Yes	Yes	Yes
Trigger over interface	Yes	Yes	Yes	Yes

[1] The maximum cable length between device and host is dependent on the bit rate and the type of coaxial cable.

[2] The maximum cable length between the device and host is dependent on the category of Ethernet cable used.

[3] Although you do not require a frame grabber, you will need an environment that supports 10 GigE including network interface adapters and switches.

[4] CoaXPress provides up to 13 watts of power per cable, at a nominal 24 volts.

Table 2: Interface comparison

Introducing the Bonito PRO

Features and benefits

Allied Vision designed and built the Bonito PRO camera family to address the needs of customers who need a high-speed interface for their application. As CoaXPress is a well defined standard, it is the right interface standard for these applications. We carefully selected the ON Semiconductor PYTHON sensors for this camera as we were able to optimize the sensor performance with the CoaXPress CXP-6 interface.

Bonito PRO cameras offer the following features and benefits:

- Extended feature set with Sequencer Control and Multiple Region of Interest selection to support advanced imaging applications
- On-board Defect Pixel and 2D Fixed Pattern Noise Correction for improved image quality
- 4 × DIN 1.0/2.3 CoaXPress connectors for secure operation in industrial environments
- Heat-dissipation optimized housing to reduce image noise
- Build-in tripod adapter and multiple mounting holes for eased system integration
- Robust, fan-less design for industrial imaging applications
- Comprehensive I/O functionality for extended control of connected system components
- Single cable solution using Trigger and Power over CoaXPress (PoCXP)

Contact us to discuss your application requirements

If you have any questions about Bonito PRO and whether or not this camera is suitable for your application, please contact our Sales team, see Chapter Contact us on page 5.

There are many applications where CoaXPress cameras are suitable. Whether you are replacing an existing system or implementing a new vision solution, a CoaXPress camera system could be the solution you are looking for. The examples above are just the tip of the iceberg! Contact us to discuss your specific application requirements.

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